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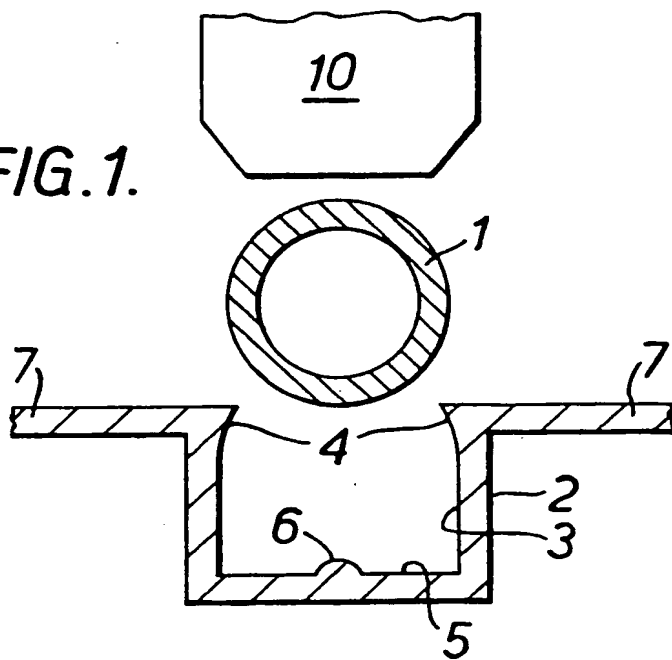
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(54) Heat exchanger panel

(57) A heat exchange element for use in, for example, solar panels comprises a metal tube (1) pressed into a metal channel (2) of rectangular cross-section with sufficient force to form separate pressure joints with the channel floor (5) and each channel side wall (3), the floor joint being spaced from each side wall joint by the corner regions of the channel.

The metal tube is preferably originally of circular cross-section and on being forced into the channel deforms to assume a re-entrant configuration at its free upper surface sufficient to promote turbulence within a heat exchange medium passing through the channel.

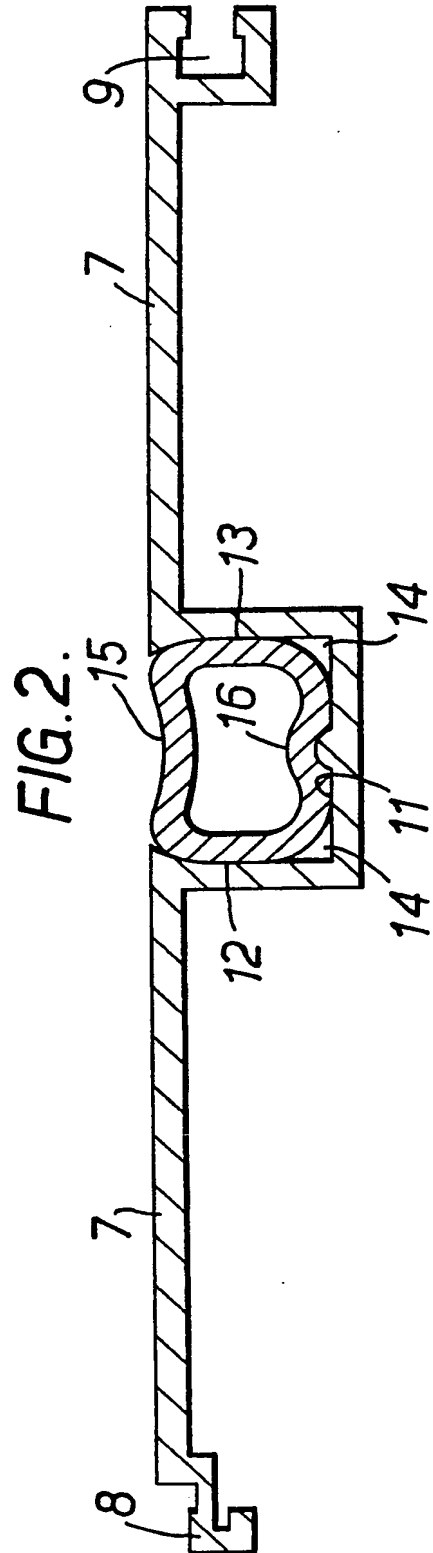
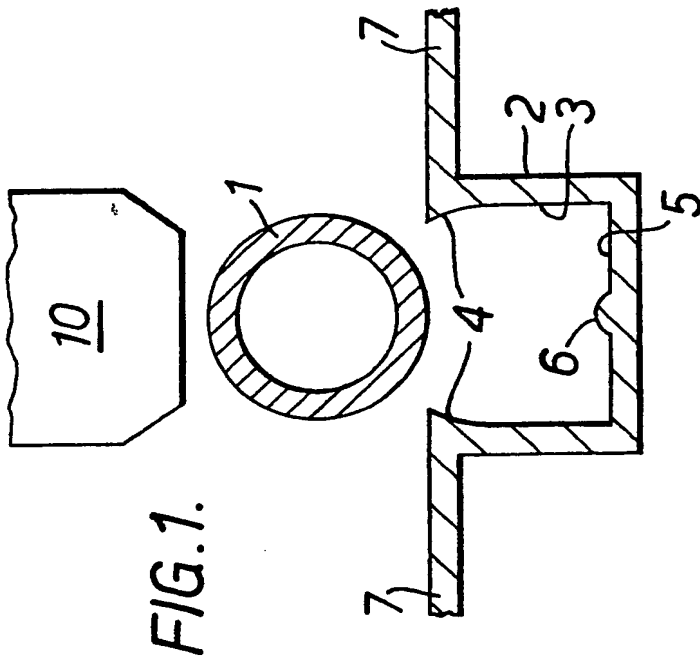
FIG.1.



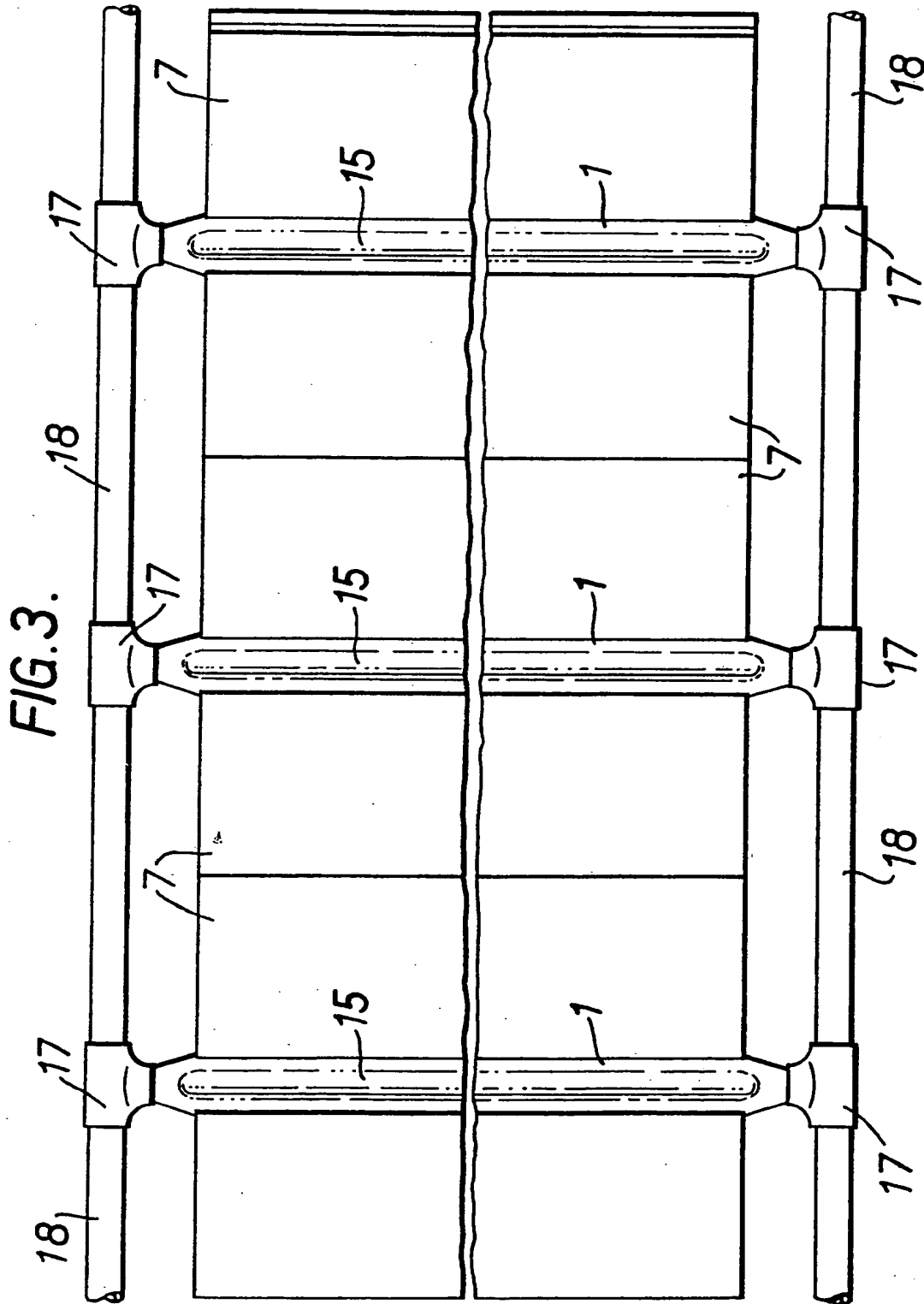
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The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

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SPECIFICATION

Heat exchange elements

5 This invention relates to heat exchange elements.
Conventionally, heat exchange elements for use,
for example, as solar heating panels or domestic
radiators, comprise a plurality of passageways
embodied within a metal panel connected to receive
10 and pass on a flow of heat exchange medium.
Generally, these passageways are defined by hot
welding or soldering together two suitably corru-
gated sheets; alternatively, screws or bolts have
been employed for this purpose. Hot welding limits
15 the choice of materials which can be adopted and
alternative conventional means of joining are com-
plicated and likely to lead to increased manufactur-
ing costs.

These disadvantages are avoided by the method
20 of construction disclosed and claimed in UK patent
No. 1530925; the present invention sets out to
provide an improved heat exchange element con-
structed generally in accordance with this method.

According to the present invention there is pro-
25 vided a heat exchange element comprising a metal
tube pressed into a metal channel of rectangular
cross-section with sufficient force to form separate
pressure joints with the channel floor and each
channel side wall, the floor joint being spaced from
30 each side wall joint by the corner regions of the
channel.

The metal tube is preferably originally of circular
cross-section and on being forced into the channel
deforms to assume a re-entrant configuration at its
35 free upper surface sufficient to promote turbulence
within a heat exchange medium passing through the
channel.

A longitudinally extending rib may be positioned
along the floor of the channel and may extend
40 continuously along the entire floor length; alterna-
tively several ribs may be positioned along the
channel floor each one being spaced from the
others. The, or each, rib may comprise a discreet
step located preferably centrally across the floor
45 width; alternatively the floor may slope upwardly
from each corner to an apex approximately mid-way
across the floor width.

Each side wall may be provided with an inwardly
protruding lip. Preferably each lip is defined by
50 suitable inclination of the walls from their upper
margins to a point approximating to one half to one
third of the wall depth.

The channelled member may be integrally formed
with lateral flanges at the channel edges. Each such
55 channelled member may comprise a single channel
or several spaced channels separated by land areas.
The channelled members may be extruded and
consist, for example, of aluminium, stainless steel,
copper or brass. The tubes may similarly consist, for
60 example, of aluminium, stainless steel, copper or
brass.

According to the present invention in another
aspect a solar heating panel comprises several metal
tubes originally of circular cross-section pressed one
65 into each of a like number of metal channel mem-

bers of rectangular cross-section, the tubes being
pressed with sufficient force to form spaced press-
ure joints with the channel floor and each channel
side wall, and land areas between the channel
70 members which define heat conducting surfaces of
the panel to heat heat exchange medium flowing
through the tubes pressed into the channels.

According to the present invention in a still further
aspect, a method of manufacturing a heat exchange
75 element comprises the steps of pressing a pipe
originally of circular cross-section into an elongated
channel of rectangular cross-section with sufficient
force to form separate pressure joints with the
channel floor and channel side walls, the floor joint
80 being spaced from each side wall joint by the corner
regions of the channel.

The invention will now be described by way of
example only with reference to the accompanying
diagrammatic drawings in which:-

85 *Figure 1* is a cross-section taken through a tube
and channelled member during construction of a
heat exchange element in accordance with the
present invention;

Figure 2 is a cross-section taken through the heat
90 exchange element illustrated in *Figure 1* following
construction; and

Figure 3 is a plan view from above of a solar panel
consisting of several heat exchange elements in
accordance with the present invention.

95 In *Figure 1*, a metal tube (1) is shown positioned
above a channelled member (2) just prior to assem-
bly. In cross-section the tube is circular and the
channel generally rectangular. The external dia-
meter of the tube is slightly less than the mouth of
100 the channel to allow an interference-free assembly of
the tube into the channel; in addition the external
tube diameter is greater than the depth of the
channel. For reasons described below, the upper end
of each side wall (3) of the channel is formed with a
105 lip (4). These lips extend to approximately one third
of the channel depth and are contoured so that they
merge with the lower two thirds of the channel walls.
Each lip surface may be straight or curved. Upstand-
ing from the floor (5) of the channel is a longitudinally
110 extending rib (6). The rib (6) may extend over the
entire channel length or alternatively a series of
spaced ribs may be provided. Whilst the rib has been
illustrated as a discreet step, alternatively the floor
(5) may be inclined upwardly from each corner to an
115 apex located approximately midway across the floor
width.

The channelled member is integrally formed with
lateral flanges (7) having complimentary tongues
and grooves (8,9) at their free edges. The member (2)
120 is preferably extruded and is manufactured from, for
example, aluminium, stainless steel, copper or
brass. The tube may similarly be manufactured from
one of these materials. In one construction the
channelled member (2) is manufactured from alumi-
125 nium and the tube from stainless steel. In any event
the respective metals for the channel member and
the tube are selected for minimal electrolytic action.

Positioned above the tube (1) is a suitably shaped
pressing tool (10) which operates to urge the tube (1)
130 downwardly into the channel with sufficient force to

produce, as shown in Figure 2, pressure joints (11, 12, 13) between the deformed tube and respectively the floor and each side wall of the channelled member. The floor pressure joint (11) is separated from each side wall pressure joint (12, 13) by the corner regions (14) of the channel. The spacings between the channel corners and the deformed tube ensure that no overstressing of the tube or channel material occurs during the pressing operation since excess material is able to flow into the corner spacings. Additionally, the spacings ensure that the correct level of tension is maintained at the pressure joints at all times. The pressure joints retain the tube securely within the channelled member and afford a significant metal-to-metal contact area throughout the length of the channel and thus provide good heat transfer characteristics. The lips (4) help to retain the deformed tube within the channel and additionally define contact areas between the tube and the upper region of the channel.

As will be apparent from Figure 2, following the pressing operation an indent (15) is formed in the upper free surface of the tube; a similar indent (16) is formed in the tube lower surface due to the presence of the rib (6). These indents are sufficient to promote turbulence within heat exchange medium flowing through the tube thereby increasing the efficiency of the heat exchange element. Additionally they accommodate differential thermal expansion of the tube relative to the channelled member which may occur during use of the heat exchange element.

Figure 3 shows a solar heating panel comprising several heat exchange elements joined together at their side edges and connected in any convenient manner by couplings (17) to pipes (18) which convey heat exchange medium to and from the tubes (1). Intermediate tubes are connected to one another by similar couplings and pipes. As will be seen from this figure, each tube (1) protrudes a short distance beyond the ends of its channel for ease of coupling, the pressing action only being carried out over the length of the channels.

As is usual with the majority of solar heating panels, the panel surface exposed to the sun is preferably coloured black or is provided with a selected finish which absorbs solar energy in the critical frequency range and does not emit solar energy.

The preferred relationship is to have the tube diameter greater than the depth of the channel and less than the width, as mentioned above, but other proportions are possible provided a good press fit can be achieved without excessive and damaging deformation of the tube. Also, although shown as being pressed fully into the channel, it is permissible to have the exposed part of the deformed tube slightly proud of the adjacent flange.

The heat exchange elements described above have many applications, these including, in addition to solar heating panels, domestic radiators and refrigeration units; thus the heat exchange medium may comprise water, heat transfer oils or a refrigerant such as ammonia.

CLAIMS (Filed on 2/7/81)

1. A heat exchange element comprising a metal tube pressed into a metal channel of rectangular cross-section with sufficient force to form separate pressure joints with the channel floor and each channel side wall, the floor joint being spaced from each side wall joint by the corner regions for the channel.
2. An element as claimed in Claim 1 wherein the metal tube is originally of circular cross-section and on being forced into the channel deforms to assume a re-entrant configuration at its free upper surface sufficient to promote turbulence within a heat exchange medium passing through the channel.
3. An element as claimed in Claim 1 or Claim 2 wherein a longitudinally extending rib is positioned along the floor of the channel and extends continuously along the entire floor length.
4. An element as claimed in Claim 1 or Claim 2 wherein several ribs are placed along a channel floor each one being spaced from the others.
5. An element as claimed in Claim 3 or Claim 4 wherein the or each rib comprises a discrete step located centrally across the floor width.
6. An element as claimed in Claim 1 or Claim 2 wherein the floor of the channel slopes upwardly from each corner to an apex approximately midway across the floor depth.
7. An element as claimed in any one of Claims 1 to 6 wherein each side wall has an inwardly protruding lip.
8. An element as claimed in Claim 7 wherein each lip is defined by inclining the walls from their upper margins to a point approximating to one half to one third of the wall depth.
9. An element as claimed in any one of the preceding claims wherein the channelled member is integrally formed with lateral flanges at the channel edges.
10. An element as claimed in Claim 9 wherein each channelled member comprises a single channel or several spaced channels separated by land areas.
11. A solar heating panel comprising several metal tubes originally of circular cross-sectional pressed one into each of a like number of metal channel members of rectangular cross-section, the tubes being pressed with sufficient force to form spaced pressure joints with the channel floor and each channel side wall, and land areas between the channel members which define heat conducting surfaces of the panel to heat heat exchange medium flowing through the tubes pressed into the channels.
12. A method of manufacturing a heat exchange element comprising the steps of manufacturing a heat exchange element comprising the steps of pressing a pipe originally of circular cross-section into an elongated channel of rectangular cross-section with sufficient force to form separate pressure joints with the channel floor and channel side walls, the floor joint being spaced from each side wall joint by the corner regions of the channel.
13. A heat exchange element substantially as herein described with reference to Figures 1 and 2 of

the accompanying diagrammatic drawings.

14. A solar heating panel substantially as herein described with reference to Figure 3 of the accompanying diagrammatic drawings.

5 15. A method of manufacturing a heat exchange element substantially as herein described with reference to Figures 1 and 2 of the accompanying diagrammatic drawings.

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